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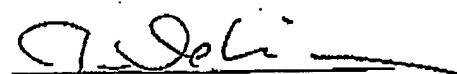
of the Japanese priority document of

Japanese Patent Application  
No. Hei 10-218192

entitled "REFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE"

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[Title of the Invention] REFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE

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[Title of the Invention]

REFLECTIVE TYPE LIQUID CRYSTAL DISPLAY DEVICE

[What Is Claimed Is:]

5 [Claim 1] A reflective type liquid crystal display device on which display is created for observation by reflecting light from a display electrode made of a reflective material, comprising:

10 a back-surface electrode disposed in contact with a back surface of the display electrode on a side opposite to a display observation side of the display electrode.

[Claim 2] The reflective type liquid crystal display device according to Claim 1, wherein

15 said back-surface electrode is made of a high melting point metal.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

20 The present invention relates to a reflective type liquid crystal display device provided with a display electrode made of a reflective material.

[0002]

[Description of the Prior Art]

25 A reflective type liquid crystal display device has been proposed wherein a display is observed by light reflected incident from the observation direction.

[0003]

Fig. 2 shows a sectional view of such a conventional

reflective type liquid crystal display device.

[0004]

As shown in Fig. 2, the conventional reflective type liquid crystal display device comprises an insulating substrate 10 having a thin film transistor (hereinafter referred to as TFT) or another switching element, an aluminum (Al) display electrode 18 connected to a switching element of the TFT, and an orientation film 22 formed thereon, and an opposite electrode substrate 20 having an opposite electrode 21 and an orientation film 22 formed thereon. The substrates oppose each other across a void, and are bonded together by an adhesive seal agent 23, and the void is filled with a liquid crystal material such as twisted nematic liquid crystal (TN liquid crystal) 30. Moreover, a polarization plate 24 is provided on the side of an observer 100 outside the liquid crystal display device.

[0005]

Natural light 40 from the outside is incident upon the polarization plate 24 on the side of the observer 100. The light is transmitted through the opposite electrode substrate 20, the opposite electrode 21, the orientation film 22, the TN liquid crystal 30, and the orientation film 22 on the TFT substrate 10, and then reflected by the display electrode 18, transmitted through the layers in a direction reverse to the incident direction, and emitted via the polarization plate 24 on the opposite electrode substrate 20 to enter the observer's eyes 100.

[0006]

Fig. 3 shows a sectional view of one display pixel

section of a conventional reflective type liquid crystal display apparatus.

[0007]

A gate electrode 11 is formed on an insulating substrate 5 10 made of glass or the like, on which an active layer 14 composed of polycrystalline silicon is formed on a gate insulating film 12 disposed over the gate electrode 11. After forming a stopper 13 composed of an insulating film on the active layer 14, a source 14s and a drain 14d are formed by 10 doping impurities in the active layer 14 using the stopper 13 as a mask. A region covered by the stopper 13 of the mask becomes a channel 14c. An inter-layer insulating film 15 is formed above the stopper 18, the active layer 14, and the gate insulating film 12.

15 [0008]

The source 14c is connected via a contact hole formed in the inter-layer insulating film 15 to a display electrode (a source electrode) 18 made of Al, while the drain 14d is connected via the contact hole formed in the inter-layer 20 insulating film 15 to a drain electrode 16 made of Al. In this manner, the insulating substrate 10 on which the TFT is thus formed, i.e. the TFT substrate 10 is completed.

[0009]

[Problems to be Solved by the Invention]

25 However, since the display electrode is formed by depositing and patterning Al by a sputtering process, protrusions are generated on a display electrode surface during the formation by sputtering. Protrusions are also generated on the display electrode surface by heat treatment

after the sputtering. Therefore, drawbacks result in that a mirror-surface reflectance is lowered and that a bright display on which external light is sufficiently reflected cannot be obtained.

5 [0010]

This invention, which was conceived in view of the aforesaid current problems, therefore aims to provide a reflective type liquid crystal display device in which protrusions cannot easily form on the surface of the display 10 electrode and the mirror-surface reflectance is enhanced to enable brighter display.

[0011]

[Means for Solving the Problems]

According to the present invention, a reflective type 15 liquid crystal display device on which display is created for observation by reflecting light from a display electrode made of a reflective material, comprises a back-surface electrode disposed in contact with a back surface of the display electrode on a side opposite to display observation side of 20 the display electrode.

[0012]

Further, the back-surface electrode is made of a high melting point metal.

[0013]

25 [Description of the Preferred Embodiments]

A reflective type liquid crystal display device according to the present invention will be described hereinafter.

[0014]

Fig. 1 shows a sectional view of one display pixel of the

reflective type liquid crystal display device of the present invention.

[0015]

As shown in Fig. 1, a gate electrode 11 formed of Cr or another metal is formed on glass or another insulating substrate 10, and an active layer 14 constituted of polycrystalline silicon is formed via a gate insulating film 12 constituted of SiO<sub>2</sub>, or another insulating film provided on the gate electrode 11. A stopper 13 made of SiO<sub>2</sub> or another insulating film is formed on the active layer 14 and, using the stopper 13 as a mask, impurities are injected to the active layer 14 to form a source 14s and a drain 14d. A portion masked by the stopper 13 forms a channel 14c. An inter-layer insulating film 15 is formed on the stopper 13, the active layer 14 and the gate insulating film 12. A contact hole is formed at a position corresponding to the drain 14d of the inter-layer insulating film 15 and a drain electrode 16 is connected through this hole.

[0016]

A flattening insulating film 17 is then formed on the inter-layer insulating film 15 and the drain electrode 16, and a contact hole is formed in a position corresponding to the source 14s in the inter-layer insulating film 15 and the flattening insulating film 17.

[0017]

Approximately 1000 angstroms of molybdenum (Mo) is deposited in the contact hole and on the flattening insulating film 17 by sputtering process, and thereupon approximately 2000 angstroms of Al is similarly deposited by the sputtering

process. Thereafter, a resist pattern for forming a display electrode 18 is formed on the Al, and the Al and Mo are etched in sequence, so that, in addition to the formation of the display electrode 18, a back-surface electrode 41 having the same shape as the display electrode 18 is formed on the back of the display electrode 18. Here, the source 14a of the flattening insulating film 17 and the inter-layer insulating 15 is connected via the contact hole formed in the position corresponding to the source 14s to the display electrode 18 which also functions as a source electrode. The insulating substrate 10 with TFT formed thereon, i.e. the TFT substrate 10, is completed in this manner.

[0018]

As shown by the dotted line in Fig. 1, natural light 40 transmitted from the outside follows a course wherein it strikes a polarization plate 24 from the side of an observer 100; is transmitted through an opposite electrode substrate 20, an opposite electrode 21, an orientation film 22, a liquid crystal 30, and an orientation film 22 on the TFT substrate 10; and is then reflected by the display electrode 18 made of Al. The light is subsequently transmitted through the layers in a direction reverse to the incident direction and emitted via the polarization plate 24 of the opposite electrode substrate 20 towards the observer's eyes 100.

[0019]

When the back-surface electrode of a high melting point metal is provided on the back surface of the display electrode 18, the crystal grain diameter of the Al is reduced. As a result, stresses are suppressed and bumps do not easily appear

on the surface.

[0020]

In addition to the above-described Mo, other high melting point metals, such as titanium (Ti), tungsten (W), tantalum 5 (Ta), chromium (Cr), can be used as the material of the back-surface electrode 41. Because, when Ti or W is used, the back-surface electrode 41 is well contacted with the source 14s, Ti and W may preferably be used as the material of the back-surface electrode. Furthermore, Ti is of a hexagonal 10 system. When Ti is used, it is well compatible with Al of a centroid cubic system in respect of a crystal lattice structure. Since Al is formed on a crystal surface which is easily placed in (111) orientation state, protrusions or bumps are not easily formed on the surface.

15 [0021]

Moreover, a twisted nematic liquid crystal (TN liquid crystal) having a birefringence control mode and using a polarization plate can be used as the liquid crystal material.

[0022]

20 As described above, when Mo, Ti, or another high melting point metal is formed in the same shape as the display electrode on the back surface of the display electrode 18, and the display electrode 18 is sputtered/formed, protrusions are not easily generated on the surface even during subsequent 25 heat treatment. Moreover, the mirror-surface reflectance of the display electrode made of Al is not lowered, and a reflective type liquid crystal display device realizing a bright display can be obtained.

[0023]

Furthermore, a thickness of the back-surface electrode 41 may be in the range of 200 to 1500 angstroms to such a degree that no protrusions are generated on the display electrode 18.

[0024]

5 Moreover, while the use of a so-called bottom gate type TFT with TFT gate electrode formed under the active layer in the reflective type liquid crystal display device has been described, similar effects are obtained when the present invention is applied to a reflective type liquid crystal 10 display device provided with a top gate type TFT in which the gate electrode is formed on the active layer.

[0025]

[Advantage of the Invention]

With the liquid crystal display device of the present 15 invention, there can be provided a reflective type liquid crystal display device in which protrusions or bumps are not easily generated on the display electrode surface, the mirror-surface reflectance is enhanced, and a bright display is obtained.

20 [Brief Description of the Drawings]

[Figure 1]

Sectional view of one display pixel section of a reflective type liquid crystal display device according to the present invention.

25 [Figure 2]

Schematic general sectional view of a conventional reflective type liquid crystal display device.

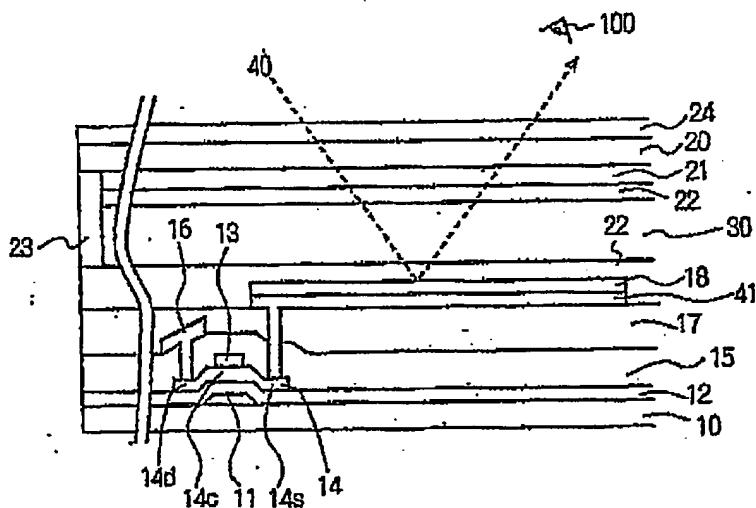
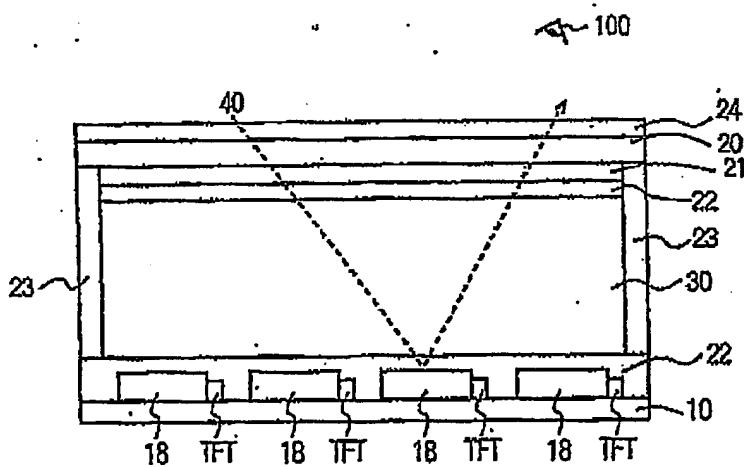
[Figure 3]

Sectional view of one display pixel section of the

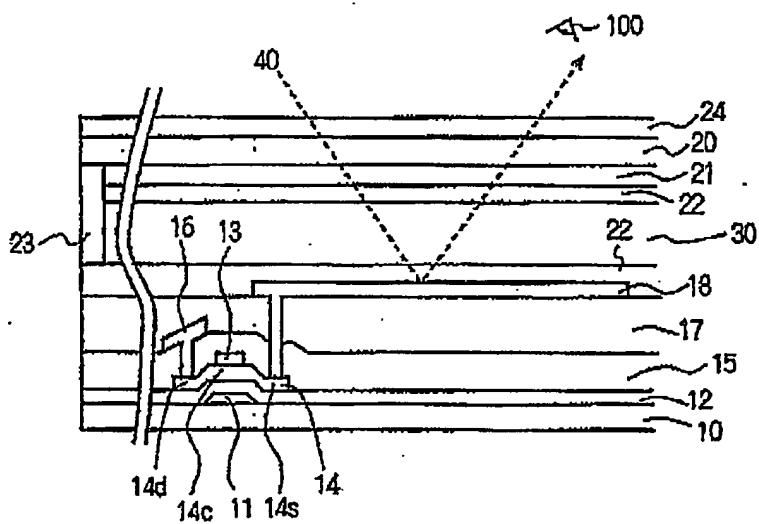
conventional reflective type liquid crystal display device.

[Designation of Numerals]

- 10   TFT substrate
- 18   display electrode
- 5     20   opposite electrode substrate
- 24   polarization plate
- 30   liquid crystal
- 40   natural light
- 41   back-surface electrode
- 10    100   observer

**[Document] Drawings****[Figure 1]****[Figure 2]**

[Figure 3]



## [Document] Abstract

## [Summary]

[Object] To provide a reflective type liquid crystal display device in which protrusions are not easily generated on a surface of a display electrode made of Al, and mirror-surface reflectance is enhanced to enable brighter display.

[Solution] An active layer 14 which has a gate electrode 11, a gate insulating film 12, a source 14s, and a drain 14d, an inter-layer insulating film 15, and a flattening insulating film 17 are sequentially laminated on an insulating substrate 10 made of Al. A display electrode 18 connected to the source 14s is disposed on the flattening insulating film 17. The display electrode 18 made of Al is provided, on a back surface thereof, with a back-surface electrode 41 made of Mo or Ti which is of a high melting point metal, to prevent the occurrence of protrusions or bumps on a surface of the display electrode 18. In addition, mirror-surface reflectance of the display electrode 18 is enhanced, thereby enabling brighter display.

[Reference Drawing] Figure 1

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